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# Russian Bibliography of 2015 Publications Linked to the Current NPAFC Science Plan

by

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**Russian Bibliography of 2015 Publications Linked to the Current NPAFC Science Plan**


## ABSTRACT

The bibliography lists original papers published in 2015 by Russian scientists and their collaborators relevant to the 2011-2015 NPAFC Science Plan. The bibliography lists 70 papers, corresponding to the five key research components of the NPAFC Science Plan.


## INTRODUCTION

The Science Sub-Committee of the North Pacific Anadromous Fish Commission (NPAFC) developed a five-year Science Plan (2011-2015). The plan includes five components: 1) Migration and survival mechanisms of juvenile salmon in the ocean ecosystems; 2) Climate impacts on Pacific salmon production in the Bering Sea (BASIS) and adjacent waters; 3) Winter survival of Pacific salmon in the North Pacific Ocean; 4) Biological monitoring of key salmon populations; and 5) Development and application of stock identification methods and models for management of Pacific salmon.

The current bibliography lists original papers published in 2015 by Russian scientists and their collaborators relevant to the 2011-2015 NPAFC Science Plan as well as other salmon studies. The bibliography lists 70 papers, corresponding to the five key research components of the NPAFC Science Plan. Each publication is listed under one research component, although some of them are relevant to several components. The references were given with abstracts if papers included abstracts in English. Otherwise, they listed without abstracts.

## BIBLIOGRAGHY

### COMPONENT 1: MIGRATION AND SURVIVAL MECHANISMS OF JUVENILE SALMON IN THE OCEAN ECOSYSTEMS

**Zelenikhina, G.S., A.N. Elnikov, and T.G. Tochilina. 2015. The downstream migration of juvenile pink and chum salmon in Reydovaya River Iturup Island (South Kuril Islands) in spring – summer season of 2014. VNIRO Proceedings 158: 6-15. (In Russian with English abstract).**
The results of researches executed in May –July, 2014 on the Iturup Island (Sakhalin region) are presented. The monitoring of downstream migration of juvenile Pacific salmon in the dark and twilight time and seining in the daylight on Reydovaya River are carried out. The short description of the hydrological regime of the river during the execution of work is given. The species composition of catches is described. The daily and seasonal dynamics of downstream migration of juvenile Pacific Salmon in Reydovaya River (Iturup Island, South Kuril Islands) in 2014 are analyzed. The quantity of migrated juvenile salmon of both species is estimated. The size-weight parameters of juvenile salmon are described during downstream migration. It was found that mass migration of pink (Oncorhynchus gorbuscha) and chum (O. keta) salmon has started when water temperature exceeds 6 °C stably and extended about 2 months. The intensity of downstream migration of juvenile pink salmon depends on water level in river; the intensity of migration of juvenile chum salmon depends mainly on luminance. Total quantity of migrated in the dark and twilight time juvenile pink salmon in 2014 were about 10.6 million fish, and chum salmon — about 3.2 million fish. The length and weight of juveniles pink and chum salmon increased during downstream migration.

**Vedishcheva, E.V., and O.F. Gritsenko. 2015. On mass return of seaward migrated chum salmon Oncorhynchus keta (Walbaum) smolts into river waters. VNIRO Proceedings 158: 16-22. (In Russian with English abstract).**
Despite the wide and rather deep knowledge of salmons, sometimes we face unusual events, such as migrations of chum salmon smolts into rivers after their long staying in sea waters. These events are of great interest. During several years VNIRO have conducted investigations of the North Kuril ichthyofauna. Among all salmons spawning in fresh-water reservoirs of the North Kurils, the abundance of chum salmon is much lower than abundance of pink, sockeye, and coho salmons. Chum salmon smolts migrated into the sea in May –June, but the expeditions began in July, so they were not registered in rivers. However, in early August, 2000 we found small concentrations of smolts off the Okhotsk Sea coast of the Paramushir Island. These concentrations stretched along the coast as a narrow strip for about 3 km to the mouth of Shelekhovka river, in which we also observed shoals of chum salmon smolts. In the next years, we conducted observations in this river, but never once fixed them there. Analyzed several hypotheses about origin of this fish, we came to the conclusion about the second return of chum salmon smolts to the river after their feeding in the sea. In our opinion, the origin of this chum is other than the North Kurils. This case allows us to estimate adaptation opportunities of chum salmon in a new way. The second return of chum salmon smolts into the river is an unique phenomenon associated with different physiological processes, including osmoregulation.

**Shulgina, E.V., and B.P. Smirnov. 2015. Determination of readiness of hatchery and wild coho salmon *Oncorhynchus kisutch* (Walbaum, 1792) juveniles for seaward migration. VNIRO Proceedings 158: 41-47. (In Russian with English abstract).**
With the use of several methods, the assessment of readiness of hatchery and wild coho salmon juveniles for downstream migration has been carried out in the basin of Lake Bolshoi Vilyui (West Kamchatka). Based on the research results, it was concluded that concentrations of glucose, hemoglobin in blood and corpuscular volume could not be used for assessment of

physiological readiness of coho salmon juveniles to downstream migration. The salinity test also does not reflect adequately the readiness of juvenile transition to marine environment. If juveniles are able to survive salinity of 40 ‰ within a day, it is reasonable to specify their physiological state by dynamics of blood osmolarity after transfer to sea water. The change in blood osmolarity under transfer to the sea water shows a degree of smoltification of coho salmon juveniles rather clearly. During the research period the blood osmolarity of hatchery juveniles exceeded considerably a freshwater level after their transfer to sea water with salinity of 30 ‰. Therefore, one-year coho salmons have not reached the final stages of smoltification yet. The juveniles of wild coho salmon with weight of more than 10 g were smolts. Their osmolarity at transition to sea water did not exceed 340 mOsm. The analysis of several methods for assessment of smoltification degree of coho salmon juveniles allowed us to conclude that under the conditions of hatchery rearing it was optimal to use the salinity test and, at the good juvenile survival, to confirm readiness for downstream migration by change in blood osmolarity after their transfer into sea water with salinity of 30 ‰.

**Frenkel, S.E., and B.P. Smirnov. 2015. Juvenile chum and pink salmon feeding in the Kurilsky Gulf (Iturup Island) in July 2010. VNIRO Proceedings 158: 61-63. (In Russian with English abstract).**

Food composition, prey size and fullness of juvenile chum Oncorhynchus keta (5.7 –8.5 cm) and pink salmon O. gorbuscha (4.4-8.9 cm) in coastal zones of Iturup Island in July 2010 have been studied. In gulf open water average stomach fullness index of juvenile pink salmon (87.4 ‰) is less than fullness of juvenile chum salmon (116.0 ‰). Calanoida were main food of both species both in the occurrence in stomachs (97 –98%) and in the proportion by weight (83 –93%). Juvenile chum salmon revealed prey size selectivity, and consumed exclusively large copepodits Neocalanus spp. (4 –5 mm). Pink salmon especially fed on small Pseudocalanus spp. (0.9 –1.5 mm), biomass of this prey was equal to 47% gross of zooplankton biomass. Total zooplankton abundance achieved 57100 inds./$m^3$, gross biomass — 710 mg/$m^3$.

**Kanzeparova, A.N., S.F. Zolotukhin, and V.F.Balushkin. 2015. Juveniles of pink and chum salmon in the Iska River (Sakhalin Bay, Okhotsk Sea) in the fresh-water period. Izv. TINRO 182: 89-195. (In Russian with English abstract).**

Juveniles of pink and chum salmon are investigated in the Iska River flowing into the Okhotsk Sea. The pink juveniles begin their seaward migration in May, with the ice melting, the migration lasts about 40 days, approximately from May 20 to July 5. The seaward migration of chum juveniles begins in the same time but ends in 5-10 days later. The portion of pink salmon fry with remains of yolk sac is 82-94 %; even in the end of their migration it is rather high, up to 76 %. This species juveniles begin to feed in the river, in particular in “dry” years, the portion of feeding fry increases with disappearance of the yolk sac up to 78 % (by the stomach fullness). Both pink and chum juveniles migrate at night only. Hydrological conditions influence on the timing of migration: it is close to normal dates in conditions of high water level and strong water flow but delayed in conditions of low water discharge (that’s why the portion of juveniles feeding in the river is higher in those years). Year-to-year dynamics of juveniles and spawners abundance is traced for 1951-2012. The pink salmon escapement to the Iska changed from 11.0 $10^3$ (in 2004) to 1344.4 $10^3$ (in 1958) ind., on average 280.0 $10^3$ ind. for even years and from 22.7 $10^3$ (in 1959) to 2005.8 $10^3$ (in 2007) ind., on average 372.9 $10^3$ ind. for odd years. The number of pink salmon downstream migrants changed from 0.8 $10^6$ (in 1954) to 40.9 $10^6$ (in 1964), on average 10.9 $10^6$ ind. for even years and from 1.0 $10^6$ (in 2005) to 41.8 $10^6$ (in 1957), on average 8.9 $10^6$ ind. for odd years.

**Tochilina, T.G., and B.P. Smirnov. 2015. Mature pink salmon juveniles *Oncorhynchus gorbuscha* (Walbaum) in the Iturup Island coastal waters (the Southern Kuril Islands). VNIRO Proceedings 158: 136-142. (In Russian with English abstract).**

The data on some morphometric parameters, growth rate, morphology of gonads, and also the analysis of scales and otoliths of mature pink salmon juveniles caught in coastal waters of the Iturup Island during autumn, 2009, are presented. Mature pink salmon juveniles at stages V and V–VI of their gonad maturity are met in waters of the Iturup Island. They constitute only a thousandth part of the total pink salmon abundance. By their biological characteristics these juveniles correspond to adult individuals of fishery stock and can participate in spawning together with fish at age 1+. From the point of view of their morphometric parameters, mature juveniles of the Iturup Island differ from normal adults by short but high head, short lower jaw and long upper jaw, and also by weight and body length. The analysis of scleritogramms of mature juveniles and adults at age of 1+ in the first year of growth did not reveal any essential differences in their growth rate. The thermal otolith marks of Japanese pink salmon released from Ichani salmon hatchery (Hokkaido) were presented in two individual of mature pink salmon juveniles. The phenomenon of early maturation requires a more careful study, with the use of genetic material.

**Esin, E.V. 2015. Developmental abnormalities in salmonids (Salmonidae) under the conditions of large-scale volcanic pollution of their spawning ground (using dolly varden *Salvelinus malma* as an example). Russian Journal of Developmental Biology 46(2): 88-98. (In English).**

Rivers originating from the areas of active volcanism in Kamchatka serve a spawning ground for anadromous and resident populations of dolly varden (Salvelinus malma). In some cases, watercourses with a long-term continuous spawning of S. malma are subjected to chronic pollution with dissolved toxicants and suspended mineral particles. The revealed development conditions range from background ("clean" rivers) to critical (most "polluted" rivers). Medium pollution leads to the development of hatchlings with abnormalities in the ethmoidal head segment, lower jaw, operculum, lobes of the paired fins, and axial skeleton (up to 40% of all specimens). Delayed ossification of skeletal elements takes place. Abnormalities in the development of spinous processes occur more often (up to 49–55% compared to 25–30% in the background areas). The average number of asymmetries per specimen (in four bilateral structures) increases from 1.1–1.4 to 1.7–2.5. Similar developmental abnormalities have been registered in underyearlings, both anadromous and resident, influenced by various pollutant combinations. While fish continue to grow, some of them die because of abnormalities; thus, their frequency in 3_year_old specimens nears the background one. Upon extreme pollution, deviant specimens are sampled at earlier developmental stages and characterized by a lower frequency of morphological abnormalities.

**Romasenko, L.V., Zakharov A.V., and Nikitin V.D. 2015. Downstream migration of pink and chum salmon juveniles in some rivers of Sakhalin region in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 112-115. (In Russian).**

## COMPONENT 2: CLIMATE IMPACTS OF PACIFIC SALMON PRODUCTION IN THE BERING SEA (BASIS) AND ADJACENT WATERS

**Bugaev, A.V., and O.B. Tepnin 2015. Productivity of Pacific salmon: influence of water thermal conditions during the period of first winter in the basin of North Pacific. VNIRO Proceedings 158: 89-111. (In Russian with English abstract).**

Ocean conditions experienced by juvenile Pacific salmon (Oncorhynchus spp.) during the first winter at sea may affect the productivity of Asian and North American populations. We evaluated potential correlations between annual commercial catches of five species of Pacific salmon and gridded satellite sea surface temperature anomalies during winter in the Bering Sea and North Pacific Ocean (October–April, 1982–2013). The strongest correlations were restricted

to the region south of the Aleutians (40–50°N latitude, 160°E — 170°W longitude), and were generally stable over time for both Asian and North American salmon. In the Bering Sea, correlations were slightly negative or neutral (close to zero), as expected given that most juvenile Pacific salmon leave the Bering Sea during winter. North Pacific waters south of the Aleutians correspond to the known area of high abundance of juvenile salmon in winter. The direction of correlations in this region was generally positive for highly abundant species (pink, chum, and sockeye) and negative for low abundance species (coho and chinook). These differences may reflect density effects between high and low abundance species during their first winter at sea.

**Vanyushin, G.P., V.A.Tsareva, T.Y. Uglova, and M.Y. Kruzhalov. 2015. Comparative evaluation of the results of the pink salmon fishery and temperature conditions of the marine environment determined by the satellite data in the South Kuril area. VNIRO Proceedings 158: 112-120. (In Russian with English abstract).**

The results of the comparative analysis of the dynamics of pink salmon catches in Southern Kuriles and temperature conditions in 2001–2015 in reference zones: in the coastal waters of the Iturup Island after seaward migration of young pink salmon in the initial period of marine life (May) and its wintering in the open North West part of the Pacific Ocean (March) are given. Average monthly temperature and anomalies of the sea surface temperature were obtained from the data of the satellite monitoring. The drop in catches of pink salmon in the coastal waters of the Southern Kuril Islands in 2011, 2014 and 2015 was, probably, connected with the unfavorable temperature conditions which were observed in May 2010, 2013 and 2014 in the Prostor Bay of the Iturup Island. Temperature was significantly lower then 3,5 °C, which is the minimum limit of the optimum temperature for providing a complete reproduction of pink salmon. There is a reason to believe that one of the decisive factors affecting the future catches of pink salmon in the South Kuriles area, as it was found in recent years, is the temperature in the Prostor Bay of the Iturup Island in May which was favorable to the earliest period of life cycle of the marine juvenile pink salmon after its seaward migration.

**Khen, G.V., and A.V Zavolokin. 2015. Change in water circulation and its implication for distribution and abundance of salmons in the western Bering Sea in the early 21 century. Izv. TINRO 181: 95-115. (In Russian with English abstract).**

Water circulation in the western Bering Sea is considered for summer and fall seasons on the data of oceanographic surveys conducted in 2002-2012 by Pacific Fisheries Research Center (TINRO) under BASIS program. In general, cyclonic circulation was observed over the deepwater basin, without prominent changes form summer to fall. However, the cyclonic gyre was wider until 2006 than later when it was limited by the Commander Basin in both seasons while the northward flow from the Near Strait became stronger and the westward flow from the Aleutian Basin along Koryak shore and the Bering Slope Current became weaker. The former inflow formed the hydrodynamic front along the border of Russian EEZ that prevented eastward spreading of the cold subsurface water. This change was connected with reconstruction of atmosphere circulation: change of the Aleutian Low orientation in spring. It extended latitudinally from Asia to North America till 2006 that favored to eastern and northeastern winds over the Bering Sea, then moved to southwest-northeast position with shift to south of its western trough, so northern and northeastern winds prevailed. After reconstruction of air and water circulation, feeding migration of immature chum, sockeye and chinook salmons to the western Bering Sea became less intensive and their abundance decreased in 2, 5, and 9 times, respectively, with corresponding changes of their distribution pattern. About 70 % of immature salmons fed in the waters of the Aleutian Basin in 2002-2006 but < 50 % in 2007-2010; their concentration density in this area decreased in 2-3 times though it did not Aleutian Low returned to latitudinal position in 2012, just as the water circulation changed back: the northward flow from the Near Strait weakened, the eastward stream appeared along Aleutian Island, the front at

the border of Russian EEZ relaxed and the cold subsurface water penetrated to the Aleutian Basin again. As the result, the feeding salmon abundance in the EEZ of Russia grew and reached the level of 2002-2006.

**Kotenev, B.N., A.S. Krovnin, N.V. Klovach, N.V. Mordasova, and G.P. Muriy 2015. Impact of climatic and oceanographic factors on the state of main pink salmon stocks, 1950–2015. VNIRO Proceedings 158: 143-161. (In Russian with English abstract).**
The relationship between thermal conditions and catch dynamics of main pink salmon stocks (Kamchatka and Sakhalin-Kuril stocks) in their feeding areas in the marginal seas and adjacent ocean waters is discussed. The oceanic warming along with cooling of the marginal seas in the 1950s–1960s resulted in a sharp decline of catches because the pink salmon abundance was formed at the estuary-coastal stage of their life. The warming of both marine and oceanic waters was favorable for growth of catches in the 1970s. The cooling of the ocean and marginal seas (1984–1988) led to decrease in abundance and weight of salmon. The general warming of the North Pacific waters created favorable conditions (mild winters, larger zooplankton biomass) for growth of pink salmon catches (1990–2000). A simultaneous warming in areas which cover all stages of pink salmon life, and especially warming of coastal waters, ensured the record high catches in 1991 and during 2005–2012. The ongoing transition from the favorable climatic regime of the 1990s–2000s to a new, unfavorable, regime of the 2020s–2030s will cause an increase in frequency of severe cooling events in the marginal seas that has already led to a sharp decrease in pink salmon catches in the Northwest Pacific during 2012–2015.

**Feldman, M.G., and E.A. Shevlyakov 2015. Survivability of Kamchatkan pink salmon from results of combine influence of density and environmental factors. Izv. TINRO. 182: 88-114. (In Russian with English abstract).**
Similarity revealed between East and West Kamchatkan pink salmon in time series of some population answers (dynamics of stock abundance and survival) indicates of same one influence of large-scale environmental factors. The factors mentioned are the Pacific Decadal Oscillation (PDO) and the Western Pacific pattern (WP). Analysis of the absolute values of the indices PDO and WP on the one hand and pink salmon population answers on the other hand has revealed significant correlations for various stages of the life cycle of pink salmon. Meantime, the dynamics of pink salmon survival itself (expressed in the ratio of R/S – recruits per parental stock) is a non-linear dependence on environmental factors and can be described by parabolic equation. That creates a basis for a model of pink salmon survival. Basic method of the modeling uses general regression model where survival is the 2nd order surface response. Such models provide highly accurate in description of fluctuations of the observed R/S values. It has been also revealed in the course of our research that the correlation between the environmental factors and pink salmon survival for certain stages of pink salmon life cycle is oppositely different in case of odd and even generations. For example, the high value of the PDO index in November correlates negatively with survival on East Kamchatka on the first year of pink salmon life (incubation period) and positively on the second year (feeding at sea), what may explain changing high and low abundant pink salmon generations. Both the PDO and WP indices demonstrate quasi-biennial cycles, which are slightly longer than the cycle of pink salmon of 2 years, and hence the climate cycles have been displacing relatively the cycle of pink salmon to provide favorable conditions for the next adjacent pink salmon generation. The changes of such kind occurs every 8 years approximately, what can be seen from spectral analyzing of pink salmon survival time series. In this way similar changing generation abundance can take place in the other salmon species (West Kamchatkan coho salmon with the cycle of 8 years demonstrated).

## COMPONENT 3: WINTER SURVIVAL OF PACIFIC SALMON IN THE NORTH PACIFIC OCEAN ECOSYSTEM

## COMPONENT 4: BIOLOGICAL MONITORING OF KEY SALMON POPULATIONS

**Bugaev, A.V., V.F. Bugaev, and E.G. Pogodaev. 2015. The age and length-weight structure of sockeye sa lmon *Oncorhynchus nerka* local stocks in some spawning-nursery lakes of Kamchatsky krai. Izv. TINRO 180: 3-38. (In Russian with English abstract).**

The age and body length-weight structure of sockeye salmon spawning stock in some spawning-nursery lakes of Southeast Kamchatka, including Dalneye (1976–2013), Blizhneye (1939–2013) and Listvennichnoye (1999–2013), was analyzed. Moreover, data on sockeye salmon spawning stock in Sarannoye Lake (1990–2013) on the Bering Island were included into the analysis too. The research was made on the archive data collected by specialists of KoTINRO (KamchatNIRO) for the period from 1930 to 2013.

Analysis of the huge temporal data pool indicates that sockeye salmon individuals get mature in mentioned lakes being: 2.2, 2.3 and 3.2 in Dalneye Lake, 1.2, 1.3, 2.1 and 2.2 in Blijeye Lake, 2.2, 2.3 and 3.3 in Listvennichnoye Lake and 2.2, 2.3, 3.2 and 3.3 in Sarannoye Lake. Normally, the total pool of fish of these (predominant) age groups can vary in samples as 70–90%.

The dynamics of the body length–weight of sockeye salmon spawners in most cases demonstrates negative trends in scope of long–term interannual variations. The decrease observed in the body length and weight is maximal for sockeye salmon males and females from Blizhneye Lake, where the temporal observation is the longest. The sockeye salmon stocks of Dalneye, Listvenichnoye and Sarannoye Lakes demonstrate same trends, but of less extent or even of almost neutral character of variations. Along that, comparison provided for the length–weight structure of the Blizhneye Lake sockeye salmon stock for a shorter period (1975–2013) reveals similarity to the stocks of the other lakes (Dalneye, Listvennichnoye, Sarannoye).

Examining the correlation between the length–weight structural variations and the age of maturation for sockeye salmon by predominant age groups) allowed to find out that the character of the correlation in the lacustrine stocks differs extensively in criterion mentioned. Nevertheless, majority of the most important authentic relations shows in general negative correlations, what says in favor of general decrease in the length and weight of sockeye salmon stocks examined in view of the age differentiation.

The analysis of the body length and weight dynamics time series mentioned has it demonstrated, that in many cases there can be traced cyclic variations of 5–10 years. As a rule, the cycles can be described as negative or positive trends in the length and weight dynamics, but anyway, only long–term time series can guarantee tracing the cycles.

**Klovach, N.V., M.A. Sedova, and A.N. El'nikov. 2015. Features of the spawning stock of chinook salmon *Oncorhynchus tshawytscha* from the Apuka River (North-Eastern Kamchatka). VNIRO Proceedings 158: 35-40. (In Russian with English abstract).**

The study of chinook salmon Oncorhynchus tshawytscha (Walbaum) in Apuka River was conducted in 2007–2011. Apuka River is the largest river of North-East Kamchatka, where at present time the secondnumerous after Kamchatka River stock population inhabits. It was ascertained that chinook salmon for the most part spent in the river 1 year before downstream migration and stay at sea during 1–4 years. During all years of observation 1.4+ and 1.3+ individuals were basic age groups among females in runs, whereas 1.2+, 1.3+, 1.4+ individuals prevailed among males. Two- (1.1+) and seven-year-old (1.6+) fishes represented by mail exclusively were extremely rear. In runs in different years females of 2–8 and males of 4-11 age classes were present. Yearly small early mating 1.2+ males less than 70 cm long were a considerable part (more than 30%) in Apuka River stock. In 2011 their percentage was less than that in previous years but at the same time the smallest 1.1+ males less than 50 cm long and 1 kg weight group was more numerous. High proportion of small early mating males and almost total absence of males 70–90 cm long in runs caused bimodal distribution of chinook salmon length

what wasn't observed earlier for chinook salmon of Kamchatka peninsula. Usually the distribution for Asian chinook salmon is close to normal. Histological analysis of males' gonads showed that small males migrated into the river with less matured gonads than big individuals. This fact indicated that they spawned later than big ones and apparently on the spawning sites located further from the Apuka River mouth than spawning sites of the bigger spawners. That allows chinook salmon to use spawning areas of the river as much as possible. Presence of a considerable proportion of small early mating males in the Apuka River chinook salmon stock allows the species to realize different life strategy depending on natural conditions.

**Esin, E.V., V.N. Leman, and S.R. Chalov. 2015. Salmon spawning topography and structure of breeding groups in the rivers of East Kamchatka during the high abundance of spawning stocks. VNIRO Proceedings 158: 48-60. (In Russian with English abstract).**
Ecological spawning structure of three the most abundant salmonid species — pink, chum and Dolly Varden was studied in the moment of synchronous reproduction in the rivers of East Kamchatka with the minimal anthropogenic impact. The results obtained showed that pink salmon is divided into two distinct spawning groups (races) with the different frequencies of coloration types of caudal fin. Two races tend to be spatially separated to spawning grounds with the different environmental conditions, the unique late spawning race occupied streams with the moveable sandy bottom, which flow from volcanoes. On the basis of attraction to spawning sites chum is divided into three races, whose representatives differ in body size and color and choose bottom sites with the different ground substrate in front of and behind the rifts, as well as on the groundwater discharges in side channels. Different characteristics of Dolly Varden spawning groups are determined by the age structure. The largest specimen occupied central spawning grounds, while more young are forced out into the tributaries and floodplain watercourses.This complex distribution of spawners enhances the fuller utilization of environment and the stabilization of population systems in times of high abundance of spawning stocks.

**Zhivoglyadov, A.A., L.A. Zhivoglyadova, and A.V. Metlenkov. 2015. Mass fish species feeding in saltwater Tunaicha Lake (South-Eastern Sakhalin) in spring, 2012. VNIRO Proceedings 158: 64-74. (In Russian with English abstract).**
Ten species of fishes were registered in the catches of throw net in the foreshore of the Tunaicha Lake (the southeast coast of Sakhalin Island, Sakhalin region, Far East of Russia) during the spring period of 2012. According to biomass there dominated Pacific redfin Tribolodon brandtii (Dybowski, 1872), whitespotted charr Salvelinus leucomaenis (Pallas, 1814), southern flathead sculpin Megalocottus platycephalus taeniopterus (Kner, 1868). The specified types, equally with starry flounder Platichthys stellatus (Pallas, 1787), are the most probable consumers of the Pacific salmons fry in the Tunaicha Lake. Feeding intensity of all the analyzed fishes was rather low. The greatest filling indexes and the widest food range were noted for whitespotted charr and starry flounder. Cannibalism (eating up their own juveniles) was revealed among southern flathead sculpin. In the stomachs of four from five analyzed species of fish Crustacea turned to be the most significant food component. Consumption of salmon juveniles by predators was insignificant. Amfibiotic insects, Crustacea, nine-spined stickleback and three-spined stickleback, pond smelt, Pacific herring were the most plentiful and available food during the specified period.

**Glubokovsky, M.K., V.A. Lepskaya, E.V. Vedishcheva, and N.V. Klovach. 2015. Fishery for Pacific salmon in the North Kuril waters: history, current status and prospects. VNIRO Proceedings 158: 75-88. (In Russian with English abstract).**
The Pacific salmon fisheries in the waters of the Northern Kuril Islands in historical retrospective, in the present period, and further perspectives of its development is analyzed. The specific geographical location of the Northern Kuril Islands to a wide extent favored first of all transit stocks removal and mainly not pink salmon but more valuable species such as sockeye

and chum salmon. A historical background of salmon catches by Japanese drift fleet and pound nets in 1933–1945 was given. In this period Japanese large scale fishery in the North Kuril waters became one of the causes of substantial fall of Pacific salmon stocks on the West Kamchatka coast. Starting from 1950 sea drift salmon fishery developed intensively, fast increasing fleet strength and catch size. In consequence of the expansion in 1950th — 1970th Japanese drift salmon fishery removed more salmon than the Soviet Union coastal catch and was one the main factors of the stocks decrease, as well as aggravated natural density decrease due to climate change in the northern hemisphere. The period of intense sea Japanese drift salmon fishery coincided with deterioration of sea feeding conditions of Pacific salmon. In 1960–1970 it led to salmon catches decline in USSR. Such a situation provoked a necessity of taking several intergovernmental steps (200-miles zone determination). The action taken along with oceanic feeding condition improvement caused by climatic changes taking place in the end of 1970–1980 was responsible for a rise of salmon stocks in the North Pacific. A list of priorities is presented, solving of the tasks is necessary for sustainable fishery arrangement for both the North Kuril's waters and water areas near North straits. A possibility of realization of economically effective fishery by pound nets and throw nets is substantiated. Fishery regulating measures directed on loss minimization to transit salmon stocks reproduced in different areas of the Sea of Okhotsk are discussed.

**Tarasyuk, E.V., and S.N. Tarasyuk. 2015. Assessment of juvenile coho salmon growth rates within different temperature conditions. VNIRO Proceedings 158: 121-135. (In Russian with English abstract).**

The observations and experimental studies were made on salmon hatcheries of the Sakhalin Island. The method of large-scale characteristics designed for quantitative descriptions of the development and growth of juvenile salmon in early ontogenesis in their artificial reproduction was applied. Regression identified based on biological indicators of embryos, free embryos, larvae and fry coho salmon based on biological age. The use of biological age allows to forecast with high accuracy the coming coho salmon hatching by any temperature in range of species tolerance. Growth of mass of body and decrease of yolk bag with high probability describes by straight line equations. The biological age which start decreasing of mass of body labels moment beginning of full value larvaes feed. Temperature from 9 to 11 degrees admittedly correspondent to temperature optimum for growing of coho salmon underyearling. The quantitative equations make it possible to simulate growth speed of coho salmon fry at different temperature conditions. The results can be used for optimizing the reproduction biotechnology of coho salmon hatcheries in favor of pasture aquaculture.

**Gorin, S.L. 2015. History of studying of Kamchatka estuary. VNIRO Proceedings 185: 167-158. (In Russian with English abstract).**

The Kamchatka River estuary is very important for Russia because it is extremely rich in fisheries (above all, salmon). Previous studies have assumed that morphodynamics evolution of the Kamchatka River estuary causes changes in salinity of the estuary and, in its turn, changes in amount of fisheries. This research involves collecting and analyzing data (historical descriptions and maps, satellite images) about evolution of the estuary since the first half of the 18th century. The detailed historical report provides readers for having their own notion of factual evidence. Basing on the historical data analysis the author has elicited following facts. Since the beginning of the 18th century the Kamchatka River estuary passed through three development cycles (three times the spit in the estuary gradually elongated and every time that process finished because of forming a new river mouth across the proximal end of the spit). The first cycle started in 1698–1717 and finished in 1768. The next one lasted till 1845–1851. The third cycle completed in 1923 (or in 1916 (?)). Since that the natural evolution of the system was interrupted by human impact (first of all, dredging carried out to keep waterways navigable). During the spit was elongating, salt concentrations in the estuary were reducing. When the salt intrusion was

stopped, waters in the estuary became fresh. After the Kamchatka River burst the spit, the estuary again became brackish.

**Gorin, S.L., M.V. Koval, A.A. Sazonov, and P.N. Terskiy. 2015. Modern hydrological regime of the Penzhina River downstream and first information about hydrological processes in the estuary (on results of expedition 2014). Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 37: 33-52. (In Russian with English abstract).**

The article demonstrates results of analysis of published and archive sources and authors' field study in the last half of summer 2014. Hydrological regime of the Penzhina River downstream is characterized in details on the base of the results. It is found that the river runoff in 1990–2012 (comparing to 1957–1980) decreased and the temperature of the river water has increased. The upper edge of tidal spreading in the river is figured out: the tidal fluctuations can spread up to 52 km from the mouth, and the reverse currents and water temperature — respectively up to 30 and 11 kms. It is revealed, that the northeastern part of Penzhinsky Bay, nearest to the river, undergoes extensive freshening in summer. Freshening in the water in the most distant from the river part of the bay spreads more than over 60 km from the river mouth.

**Koval, M.V., E.V. Esin, A.V. Bugaev et al. 2015. Freshwater ichthyofauna of the Penzhina and Talovka Rivers (North-West Kamchatka). Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 37: 53-145. (In Russian with English abstract).**

Revision of the composition of freshwater ichthyofauna of the Penzhina and Talovka Rivers is made on the base of current and archive literature sources and field materials for May–October, 2008–2014. Distribution, life cycle, population structure and feeding has been clarified for 21 species of local fish fauna, and history of forming local freshwater fish communities has been suggested. Local names, morphological description and original images of the fish have been provided. Current state of population abundance and commercial status has been estimated. It has been revealed that in current physical and geographic conditions revised systems operate as one spawningnursery system for majority of resident species, because the overlapping mouths of the systems and freshening in summer months create extensive transit habitat for the fish. United population systems in the rivers are used by some of semi-anadromous and anadromous species, including pond smelt and toothed smelt, chum and pink salmon, ninespine stickleback and most likely threespine stickleback. The biological specifics of the residential fish populations in the systems is determined by features of local habitat conditions and community-supported fishery. Judging by majority of biological indexes, the Talovka River provides favorable feeding and spawning conditions for limnetic-fluvial and limnophylic species, whereas the Penzhina River – for fluvial and reophilic ones. Comparing the other river systems in the North-East of Russia, the conditions in the Penzhina and Talovka Rivers are generally more favorable for majority of resident fish populations. It is due to mild climate, stable feeding conditions for the fish of all age groups and types of feeding and low fishery pressure to the populations.

**Koval, M.V., S.L. Gorin, A.V. Bugaev, O.V. Frolov, and M.V. Zharavin. 2015. Longterm dynamics and modern state of commercial fish resource in the Penzhina and Talovka Rivers (Northwest Kamchatka). Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 37: 146-163. (In Russian with English abstract).**

Modern state and long-term dynamics of commercial fish species resource was studied first time in the rivers Penzhina and Talovka (Northwest Kamchatka) on the base of available modern and archive literature data and results obtained by authors in 2014. It has been found that the most perspective commercial objects in the systems of the rivers would be chum salmon, Kamchatka grayling, pike, round whitefish, pizhyan and burbot, whereas in the mouth area — smelts and

saffron cod. There is no commercial fishing now in the area mentioned. A small part of this resource has been developing by local native people for food or for purposes of sport or amateur fishing only. Stock of broad whitefish has been undermined in recent years in view of in-fact absence of state control, and now the species does not play commercial role anymore. Populations of Penzhina omul and siberian cisco also have been under intense pressure of amateur fishing, what is determining stock abundance decrease in the coming years.

**Koval, M.V., S.L. Gorin, and A.A. Kalugin. 2015. Ecological characteristic of nectobenthos and juvenile fish community of hypertidal estuary of Penzhina and Talovka Rivers (Northwest Kamchatka) in August 2014. Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 37: 164-191. (In Russian with English abstract).**

The article demonstrates preliminary results of ichthyological research, carried out in August 2014 in the mouth area of Penzhina and Talovka Rivers and in the adjacent waters of Penzhinskaya Bay (the hypertidal estuary of Penzhina and Talovka). Habitat abiotic conditions, species composition and spatial distribution of hydrobiont communities, distribution density and migrations of hydrobionts in the estuary were estimated. Biological parameters (size and age composition) of fish and nectobenthos (size composition) was made, and juvenile fish feeding and food interactions were studied. Anthropogenic effects in the ecosystem of the estuary were estimated. A huge difference in biological diversity due to the occurrence of continental fish fauna representatives (absent in the other rivers of Kamchatka) was revealed for the estuary of Penzhina and Talovka comparing it to the other river mouth areas in Kamchatka Peninsula. Moreover, some mass coastal fish species, regular in the other rivers of the Sea of Okhotsk system, were not observed in mentioned estuary. The specifics of the species composition of the fish community in studied estuary directly relates to the specifics of physical and geographical conditions in the system of Penzhina and Talovka and to the features of hydrological regime in the upper part of Penzhinskaya Bay. The estuary is much more productive in the biological sense comparing it to all other studied river estuaries in Kamchatka. An indication of that is a high abundance and biomass of hydrobionts, a narrow spectrum of food and a high intensity of juvenile feeding of all fish species. It has been suggested that principal determinants of the high production ability of the estuary are a great flow of organic matter with the runoff from the Penzhina and Talovka Rivers (what creates a basis of trophic pyramid) and almost absolute absence of anthropogenic pressure on the local ecosystem.

**Esin, E.V., N.S. Mugue, Y.V. Sorokin, and O.O. Koval'. 2015. Isolated charrs of the genus Salvelinus (Salmonidae) from lakes of the Uzon Caldera, Kamchatka: II. Charr of lake Tsentral'noe. Journal of Ichthyology 55(1): 105-118. (In English).**

The charrs of the genus Salvelinus from the upper part of the Shumnaya River basin forage in the shallow thermal lake, and downstream spawning migration to the river and its tributaries is registered in early fall. The life span of the fishes is no longer than eleven years, maximum body length and weight reach 55 cm and 1.6 kg, respectively. The abundance of the spawning group is approximately 350--400 individuals. The population is characterized by the presence of single ) haplotype of the Cyt b--D-loop region of mtDNA, which is found in Dolly Varden S. malma@populations. The charrs of Lake Tsentral'noe and Lake Dal'nee are similar in morphology, and the origin of populations of the Uzon Caldera from a common ancestor is supposed. The charrs of Lake Tsentral'noe differ from anadromous Dolly Varden in larger head with elongated gill cover, deep caudal peduncle, larger number of rays in the unpaired fins, and larger number of pyloric caeca. Based on shapes of the skull bones, the isolated populations from the Uzon Caldera are characterized by narrow suspensorium, narrow head of the vomer, shortened anterior part of the parasphenoid, and elongated upper jaw. All observed differences are based on frequency distributions of the characters, and well-defined parameters for discrimination of the isolated populations and anadromous Dolly Varden are not revealed.

**Busarova, O.Yu., and E.V. Esin. 2015. Parasite Fauna of Landlocked Dolly Varden (Salvelinus, Salmonidae) from the River–Lake System of Uzon Caldera (Kamchatka). Journal of Ichthyology 55(6): 743–743. (In Russian with English abstract).**
Parasitological research of two landlocked populations of Dolly Varden (Salvelinus malma) dwelling the river–lake system in the Uzon caldera (Kamchatka) was done for the first time. Twelve species of fresh_water parasites were found. Charrs from the Lake Tsentral'noe – Shumnaya River were infected by Eubothrium salvelini, Dyphyllobotrium ditremum, D. dendriticum, Crepidostomum farionis, Cr. metoecus, Ichthyocotylurus erraticus, Sterliadochona ephemeridarum, Philonema oncorhynchi, and Cucullanus truttae. Charrs from the Lake Dal'nee were infected by Henneguya zschokkei, Chloromyxum coregoni, Proteocephalus longicollis, and Cucullanus truttae. Based on stomachs content and parasites abundance, it was found that charrs from the Lake Dal'nee feed on plankton, and at length more than 12 cm, switch to cannibalism. In the contrast, charrs from the Lake Tsentral'noe and Shumnaya River primarily feed on benthos and rarely on plankton, and no cannibalistic specimens were found.

**Esin, E.V. Stream resident Dolly Varden *Salvelinus malma* of Kamchatka Peninsula. Journal of Ichthyology 55(2): 224-239. (In Russian with English abstract).**
Biological features of six groups of stream resident Dolly Varden Salvelinus malma from the Kamchatka water courses with a different habitat conditions have been studied. Stream form over the entire peninsula is characterized by a low rate of growth and a similar exterior against the background of paedomorphic morphological reduction. The lifespan in different streams varies from 5 to 9 years, the number of spawning cycles varies from 1 to 4, and fecundity varies from 85 to 470 eggs. In populations of chars with eggs smaller than 3.5 mm, retardation of the formation and differentiation of bony structures in postembryogenesis has been observed. In the water courses exposed to the long_term natural volcanogenic pollution aberrations of development, high fluctuating asymmetry, and increased dispersion of morphometric traits of chars were revealed. The most specialized population that in the majority of its biological characteristics is closely related to Dolly Varden of the southern Kurils was found in the thermal water course of southwestern extremity of the peninsula

**Senchukova, A.L., S.D. Pavlov, G.N. Markevich, E.V. Esin, and N.S. Mugue. 2015. Charrs of the genus Salvelinus from Nachikinskoe Lake (Kamchatka Peninsula) and their position in the phylogenetic system of the S. alpinus-S. malma complex. Journal of Ichthyology 55(1): 97-104. (In Russian with English abstract).**
The nucleotide sequences of two regions of the mitochondrial genome (D_loop region and Cyt b gene) have been determined for the first time in sympatric charrs of the genus Salvelinus from Nachikinskoe Lake (Kamchatka Peninsula, Russia) and compared to mitochondrial DNA sequences deposited in GenBank. The level of nucleotide differences in the two regions of mitochondrial DNA in these two sympatric charrs was found to be rather high (15–20 mutations). These results confirm the presence in Nachikinskoe Lake of two sympatric forms of charr representing two genetic groups: Arctic charr (Salvelinus alpinus complex) and Dolly Varden (S. malma complex).

**Esin, E.V., and Yu.V. Sorokin. 2015. Effect of Volcanism on Environmental Conditions and Fauna in Rivers of Eastern Kamchatka (Using the Example of Watercourses Flowing from Kikhpinych Volcano). Inland Water Biology 4: 31–44. (In English)**
The effect of local factors, including the input of pyroclastic rocks and juvenile volcanic waters, on the structure and abundance of zoobenthos and fish in small watercourses of the eastern volcanic belt of Kamchatka has been studied in the summer period. Streams subjected to the minimal effect of the volcano are characterized by a high diversity and abundance of benthos, aggregations of juveniles in low_water season, and spawning accumulations of fish. Water

turbidity, pollution with toxicants, and drying up degrade communities. The rise in water temperature results in an increase in abundance and biomass due to some species of chironomids and caddis flies.

**Chalov, S.R., and E.V. Esin. 2015. The principles of ecological classification of rivers in areas of contemporary volcanism (Exemplified by Kamchatka). Geography and Natural Resources 36(1): 62-69. (In English)**

We examine the diversity of formation conditions for river ecosystems within the boundaries of the volcanic territories of Kamchatka in the context of the specific changes in water discharge, turbidity and sediment yield, the temperature and channel regimes as well as in chemical composition of river waters. On the basis of ranking the factors under consideration according to the degree of impact on the state of communities of aquatic organisms, we explore the possibilities for a classification of rivers. An analysis is made of the ecological consequences of the manifestation of volcanic processes for the diversity, structure and spatiotemporal distribution of the fish fauna. An assessment is made of the conditions under which there is taking place a degradation and extinction of the ichthyofauna. We suggest a subdivision of the streams of the volcanic territories into three groups: without specific manifestations (ordinary rivers), with volcanic manifestations, and volcanic rivers.

**Saltykova, E.A., K.V. Kuzishchin, G.N. Markevich, and E.V. Esin. 2015. Structure of "species flocks" in fishes: Channels of the splanchnocranium divergence in endemic lacustrine benthivorous charrs (Salvelinus, Salmonidae, Teleostei) in Lake Kronotskoye, Kamchatka. Doklady Biological Sciences 464(1): 226-229. (In English).**

Diversity of oral apparatus structure of the 4 endemic benthivorous charrs from lake Kronotskoe was studied.

**Esin, E.V. 2015. Review of toxicity for the main chemical elements — pollutants of salmonid spawning rivers in Kamchatka. Izv. TINRO 180: 210-225. (In Russian with English abstract).**

Toxicological tests of salmons on acute and chronic critical concentrations of 15 chemical elements (Cu, Zn, Pb, Co, Ni, Mn, Sb, Al, Fe, Mo, V, Se, S, As, B) are executed and compared with cited data, with special attention to mechanisms of the toxins physiological effects on fish, including their synergistic and antagonistic influence. These elements are the most common pollutants of spawning rivers in Kamchatka. For better comparability, the standard test object is used, as rainbow trout. Regional amendments to the normative standards of anthropogenic discharges are proposed.

**Esin, E.V., S.L. Gorin, and S.R. Chalov. 2015. Atlas-key to fish of Kamchatka and adjacent areas. Moscow. VNIRO Publishing 144 p. (In Russian).**

The monograph includes illustrated reference materials characterizing diversity and main life cycle stages of fish inhabited streams, rivers, lakes, and estuaries of Kamchatka peninsula and adjacent areas. Short reviews on species biology are supplemented by photos of the fish in vital colors. For ichthyologists, fishery managers, fish-farmers, observers, and environmental authorities experts, lecturers, students, and fishermen as well.

**Metalnikova, K.V. 2015. On the possibility of practical use of different methods to evaluate the quality status of fish populations on the example of the Chinook. Aquaculture today. All-Russian Research Institute for Irrigation Fisheries Publishing 174-182. (In Russian with English abstract).**

For the purpose of an estimation of a qualitative condition let out smolt of salmon fishes - of the future high-grade manufacturers - defined heritability of the sizes of caviar at manufacturers of females under the formula Volohonsky-Viktorovsky. Have spent an estimation of posterity of

manufacturers' chinook on level, synchronism of development of embryos and at smolt on a condition of an internal before release to a natural reservoir with use of a histologic method, applying various ways of dehydration of preparations at histologic processing.

**Leman, V.N., T.R. Mikhailova, and V.E. Kirichenko. 2015. Poaching impact assessment on small salmon rivers (Kamchatka). Problems of Fishiries 16(1):40-48. (In Russian with English abstract).**

Poaching impact assessment on population level is provided for two small salmon rivers. Assessment refers both for the period before road construction and after road construction that made available access to previously hardly accessible remote locations. The overall length of unauthorized access roads (including unsurfaced roads, turnoffs, and pass ways) within the River Kol has been increased thrice during the last 10-15 years. This is resulted in 4-8 times reduction of spawning significance of the Tolmacheva River for the salmon enhancement.

**Chebanova, V.V., S.E. Frenkel, and G.S. Zelenikhina. 2015. Feeding and Food Relationships of Juvenile Chum Salmon (*Oncorhynchus keta*) and Pink Salmon (*O. gorbuscha*) in Coastal Waters of Prostor Bay (Iturup Island). Journal of Ichthyology 55(5): 671–678. (In English).**

The feeding behavior of juvenile chum salmon (Oncorhynchus keta) and pink salmon (Oncorhynchus gorbuscha) is given for the period of their joint fattening in the coastal waters of Prostor Bay (Iturup Island). Investigations show decrease of variability in food content and stomach fullness indexes while juveniles move from shallow_water towards the open sea. Feeding selectivity of chum salmon and pink salmon for some species of copepods is studied and is shown to reduce tension in food relationships. High infestation of juveniles with trematode Brachyphallus cronatus is identified.

**Zaporozhets, O.M., and G.V. Zaporozhets. 2015. The assessment of chum, sockeye and Coho salmon stocks in the basin of the river Bolshaya (West Kamchatka) in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 62-66. (In Russian).**

The escapement of Pacific salmon to spawn in the basin of the river Bolshaya normally is estimated from helicopter. Problems with financing in 2015 made the flights impossible, and the escapement was estimated on the results of observations from the shore or on-boat . Results of the observations in the upper part of the basin indicated of ~60-70% escapements of chum, coho amd late sockeye salmon in 2015 comparing the escapement averaged for recent 10 years: chum salmon ~15-17 thousand (the catch in the river and in the sea ~ 1,7x106 specs), coho salmon ~9-10 thousand specs (the catch in the river and in the sea ~ 0,8x106 specs), late riverine sockeye salmon ~55-62 thousand specs, including 30-35 thous. specs entered the lake Nachikinskoye to spawn (the catch in the river and in the sea ~ 1,2x106 specs). In the other words the total (legal and illegal) removal of chum and coho salmon in the river Bolshaya was ~99 % and of sockeye salmon ~95% of run. Protection of salmon spawning grounds and migration routes in 2015 was ineffective.

**Zakharova, O.A., and V.F. Bugaev. 2015. Age structure of Western-Kamchatkan masu salmon *Oncorhynchus masou*. Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 38: 39–48. (In Russian with English abstract).**

The age structure of mature masu salmon has been analyzed in several streams of West Kamchatka, including Bolshaya (for 1989–2014), Utka (2000–2014), Kikhchik (1982–2014), Krutogorova (1990–2013), Vorovskaya (1996–2014) and Khairyuzova (1990–2011). Five age groups have been revealed: 1.1, 2.1, 3.1, 1.2 and 2.2, where the age groups 2.1 and 1.1 represent respectively 71,0% and 27,2% of all fishes. Methodical approaches for evaluation how long is marine period of masu salmon on West Kamchatka have been discussed.

**Gorodovskaya, S.B., and A.S. Sushkevich. 2015. Rate of oogenesis of juvenile of Pacific salmon in the Okhotsk sea in fall 2011–2013. Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 36: 64–41. (In Russian with English abstract).**

It is first time when differences in the rates of oogenesis have been demonstrated for juvenile representatives of Pacific salmon species with different life cycles in the fall period of their feeding at sea on the base of hystological analysis of gonads. Gonads of immature chum salmon individuals have been analyzed for the fall period of their feeding in the waters of the Sea of Okhotsk.

**Shuntov, V.P., O.S. Temnykh, and V.A. Shevlyakov. 2015. Salmon fishing season–2015: successes and failures, contrasts "north-south". Bulletin of Pacific salmon studies in the Russian Far East 10: 3-15. (In Russian).**

**Shevlyakov, E.A., S.V. Shubkin, I.N. Kireev, and I.N. Yanchenko. 2015. Data about spawn process of winter Coho salmon in basin of River Kamchatka in January 2015. Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 36: 67–71. (In Russian with English abstract).**

Results of visual counting coho salmon individuals of late morph in the upper reaches of Kamchatka River in January 2015 are represented. There were 2500 $m^2$ of spawning grounds observed from the river shores to estimate the abundance of spawning coho salmon on the plot of 70 kms from Milkovo Settlement to Sharomy Village. An expert estimation is provided for the abundance of the late morph of coho, entering the Kamchatka River basin. Biostatistical data are collected and age composition of spawners is figured out.

**Lisenko, A.V., N.I. Krupyanko, and E.I. Barabanshikov. 2015. Results of stock monitoring and reproduction of chum in the Primorskiy region in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 56-61. (In Russian).**

**Kaev, A.M., A.V. Musikhin, and A.A. Skrypnik. 2015. Results of the pink salmon growth study based on their scales from various districts of the eastern Sakhalin and Iturup Island in 2014. Bulletin of Pacific salmon studies in the Russian Far East 10: 106-111. (In Russian).**

**Somov, A.A. 2015. Composition, structure, and dynamics of nekton in the upper epipelagic layer in the Aleutian and Commander Basins of the western Bering Sea in the fall periods of 2002-2013. Izv. TINRO 180: 39-64. (In Russian with English abstract).**

Species composition and abundance of nekton and their interannual variation are considered for the upper epipelagic layer (0-50 m) in the Aleutian and Commander deep-water basins of the western Bering Sea on the data of surveys conducted by Pacific Fish. Res. Center (TINRO) in September-October of 2002-2013. Dominant species were similar for both areas: the most abundant ones were chum salmon *Oncorhynchus keta* and boreopacific gonate squid *Boreoteuthis borealis*. Simpson index of domination was higher in the Aleutian Basin and these indices in two areas changed synchronously until 2009 but later they became closer and changed asynchronously. Either chum salmon or the squid dominated usually with some years as exclusion. South-boreal and subtropical species were more abundant in the Commander Basin, in particular in 2006, 2008 and 2012. Year-to-year dynamics of certain species were statistically similar, but its nature was unclear. The total biomass of nekton decreased after the climate regime shift in 2006-2007 from 3241 to 1736 kg/$km^2$ (in 46 %) in the Aleutian Basin and from 2459 to 1976 kg/$km^2$ (in 20 %) in the Commander Basin.

**Golub', E.V., A.P. Golub', S.B. Baranov, Y.A. Diachkova and U.V. Bauer. 2015. The research and harvest of the Pacific salmon in Chukotka in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 50-55. (In Russian).**

**Kanzeparova, A.N. and S.F. Zolotukhin. 2015. Pink salmon fishing season in the northwestern part of the Okhotsk Sea. Bulletin of Pacific salmon studies in the Russian Far East 10: 47-49. (In Russian).**

**Stekol'shchikova, M.Yu. 2015. Some results of monitoring for the pink salmon hatchery stocks from the Aniva Bay (Sakhalin Island). Izv. TINRO 183: 51-60. (In Russian with English abstract).**
Several population parameters (length and dynamics of spawning run, size-sex composition, variability of morphological and physiological characteristics) are determined and indices of survival are calculated for the pink salmon hatchery stocks from the Aniva Bay of the 2008–2011 generations on the base of the cultured pink salmon differentiation by thermal marks on otoliths. The hatchery pink salmon begin their migration to the bay rivers in late July, together with the wild fish. Size-weight parameters of the fish and their variability are similar for the hatchery and wild stocks in this period, obviously because of low impact of hatcheries on natural reproduction and high portion of wild fish among the spawners used in the hatcheries (> 50 %). Mean portion of the hatchery-reared pink salmon on spawning grounds of the main rivers was 17.9 % in the 2010–2013, the coefficients of their return varied from 1.0 % to 6.4 % that was lower than for the wild fish.

**Romasenko, L.V., Zakharov A.V., and V.D. Nikitin. 2015. Biological characteristic of pink salmon in some areas of Sakhalin region in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 116-120. (In Russian).**

**Volobuev, V.V., V.V. Ovchinnikov, M.V. Volobuev, and I.S. Golovanov. 2015. Salmon fishing season in 2015 in Magadan region. Bulletin of Pacific salmon studies in the Russian Far East 10: 41-46. (In Russian).**
Data on a salmon fishery in the Magadan region are presented . The results reached in season of salmon fishery are given. It is shown catch of salmon by species and categories of users. Results of scientific support of the fishery salmon during a season of 2015 are resulted.

**Marchenrko, S.L., V.V. Volobuev, and M.V. Volobuev. 2015. State reserves and fishing of chum salmon of the mainland coast of the Okhotsk Sea. Problems of fisheries 16 (2): 160-174. (In Russian with English abstract).**
Reviewed the main periods of the Okhotsk sea chum salmon quantity in dynamic research due to climatic and anthropogenic factors. The most important among them are two peaks connected with the total increasing of salmon biomass in the Northern Pacific in 1930th and in 1990th of XX century. Shown the changing of the main biological characteristics of chum salmon connected with the quantity level of its approach. Estimated the divisible factors of chum salmon natural reproduction from 4 (four) main stocks – Gizshiga, Yamsk, Tayisk and Okhotsk. It is shown that ratio of reproduction depends on the number of parent stocks, and coefficients of this factor for generations of different numbers are given.

**Bugaev, A.V., N.A. Rastyagaeva, N.N. Romadenkova et al. 2015. Results of the long-term biological monitoring of Pacific salmon of the hatcheries of Kamchatsky krai. Izv. TINRO 180: 273-309. (In Russian with English abstract).**
Several biological issues in relation to developing Pacific salmon artificial production in region were analyzed on the base of data of long-term (2001–2013) monitoring of hatchery Pacific

salmon in Kamchatka. Results of the analysis were demonstrated in the research fields as: 1) hatchery salmon stock abundance dynamics in the water bodies of salmon hatcheries (SHs), 2) otolith marking, 3) biological state of juvenile and adult fish, 4) epizootic state of the hatcheries, 5) an assessment of effectiveness and prospects of hatchery salmon production in Kamchatka.
The Pacific salmon species cultivated in the salmon hatcheries of Kamchatka include chum salmon (~ 60–70%), sockeye salmon (~ 25–30%), Chinook salmon (~ 2–3%) and coho salmon (~ 2–3%). The total average annual hatchery release in Kamchatka for the period 2001–2013 was about 36 million fishes. The general attention is paid to cultivation of highly valuable species, including Chinook, sockeye and coho salmons. The structural contribution of these species to the summary release of Pacific salmon from all Far Eastern hatcheries is averagely 100, 95 and 35 %. Along that, the total release of hatchery chum salmon from Kamchatkan SHs does not exceed 3–5 % in the total release.
The total level of the average annual return of hatchery salmon is about 38 thousand fishes. The coefficients of returns (CR) indicate of relatively poor effectiveness of the work of the SHs in Kamchatka. In most cases the coefficients are visibly less than 1%. The highest CR of 2,10% was estimated for Malkinsky SH, where local thermal water has been used for rearing juvenile fish in the hatchery.
The major problems revealed in the analysis and hindering more effective work of Kamchatkan SHs are: illegal fishing (poaching) and imperfect technologies of rearing. It is strictly required also to comply all technical standards in the course of otolith marking of hatchery salmon.
The potential of ranching Pacific salmon in Kamchatka deserves enlarging in view of a highly unstable nature of Pacific salmon as one of aquatic bioresources. The work should be strictly coordinated with principles of rational distribution of efforts and funds to support environmental conditions for reproduction of wild salmon populations and to regulate traditional fishery as measures of minimization of potential structural effects of hatchery fish in the total Far Eastern Pacific salmon stock.

**Shevlyakov, E.A., V.A. Dubynin, V.F. Bugaev et al. 2015. The the coastal fishery of Pacific salmon in Kamchatka in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 16-34. (In Russian).**

The fishery campaign of Pacific salmon in Kamchatka territory in 2015 has been analyzed and described by species. Data about the beginning and the end of fishing by fishery districts of Kamchatka, accuracy of forecast expectations and regulation measures, catches, catch dynamics and biological condition of fish are demonstrated. Information on the status of the Pacific salmon escapement as a result of monitoring from helicopter is provided for 1999-2015.

**Shubkin, S.V., and I.N. Kireev. 2015. The density of the Pacific salmon escapement in the control rivers of Kamchatka in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 165-175. (In Russian).**

The escapement of adult Pacific salmon in the rivers of Kamchatka territory has been demonstrated on the results of the observations from the air in 2015. The scheme of the flights, the distribution of the spawning grounds and the distribution of the fish in the the spawning grounds are demonstrated.

**Goryainov, A.A., and V.G. Markovtsev. 2015. Estimation of chum salmon spawning areas and some of the Primorye rivers. Bulletin of Pacific salmon studies in the Russian Far East 10: 127-135. (In Russian).**

**Temnykh, O.S., A.N. Starovoytov, A.L. Figurkin, and O.A. Maznikova. 2015 New data of immature chum feeding migration in the northwestern Pacific Ocean and the Okhotsk Sea. Bulletin of Pacific salmon studies in the Russian Far East 10: 96-105. (In Russian).**

## COMPONENT 5: DEVELOPMENT AND APPLICATIONS OF STOCK IDENTIFICATION METHODS AND MODELS FOR MANAGEMENT OF PACIFIC SALMON

**Khrustaleva, A.M., N.V. Klovach, E.V. Vedischeva, and J.E. Seeb. 2015. Genetic differentiation of sockeye salmon *Oncorhynchus nerka* from Kamchatka River basin and the lake–river systems of the west coast of the bering sea as inferred from data on single nucleotide polymorphism. Russian Journal of Genetics 51(10): 980-991. (In English).**
The variability of 45 single nucleotide polymorphism loci (SNP) was studied in sockeye salmon from the Kamchatka River basin and four lake–river systems of the west coast of the Bering Sea. Based on the genetic differentiation estimates for the largest sockeye salmon populations of Eastern Kamchatka and Chukotka, the examined samples were combined into two regional groups represented by the population of the Kamchatka River drainage, which included numerous local subpopulations and seasonal races, and the northern population grouping from the rivers of Olutorsko–Navarinsky region, wherein the sockeye salmon from Maynypilginskaya Lake–River system was relatively isolated. Considerable divergence was observed between the island (Sarannoe Lake, Bering Island) and continental populations. Genetic heterogeneity was revealed and groups of early and late maturing individuals were identified in the sample of late run sockeye salmon from Kamchatka River. In Apuka River, subdivision of the spawning run into two genetically distinct spatial and temporal groupings was also observed. The results suggested that the differentiation of sockeye salmon samples by single nucleotide substitution frequencies was largely due to differences in the direction and strength of local selection at some loci in the population complexes and intrapopulation groupings from the examined river basins of Eastern Kamchatka, Chukotka, and Commander Islands.

**Khrustaleva, A.M., and N.V. Klovach. 2015. Intrapopulation differentiation of sockeye salmon *Oncorhynchus nerka* of the lake-river systems on eastern coast of Kamchatka. Izv. TINRO 183: 27-40. (In Russian with English abstract).**
Intrapopulation differentiation of the two large population systems of sockeye salmon from the Kamchatka and Apuka Rivers in East Kamchatka is considered by analysis of 45 SNP loci. Four samples were analyzed: 2 from the lower Kamchatka River (20 specimens for early run and 100 specimens for late run), 1 from the basin of Lake Azabachye belonged to the same system (n = 81), and 1 from the Apuka River (53 specimens for mass run). No genetic differences were found between the samples for early run and late run in the Kamchatka River, though the late run sockeye could be subdivided into two genetically and morphologically different groupings, probably spawning in different biotopes: the fist represented by small, fast-growing and early maturing individuals and the second represented by bigger, late maturing ones. For the Apuka River, the hypothesis was corroborated on simultaneous run of two genetically and ecologically different groupings of sockeye salmon: they differed statistically by allele and genotype frequencies of SNP loci. The intrapopulation differentiation is comparable or even exceeds the interpopulation differences for sockeye salmon of neighbor populations, though it is unobvious for geographically remote populations. This differentiation is supposedly caused by differences of natural selection in some SNP loci for different habitats.

**Khrustaleva, A.M., and N.V. Klovach. 2015. Population structure of sockeye salmon *Oncorhynchus nerka* from north-east Kamchatka coast, Chukotka and Commander Islands. VNIRO Proceedings 158: 23-34. (In Russian with English abstract).**
The spatial genetic structure of sockeye salmon from East and North-East Kamchatka and some rivers of the West Coast of Bering Sea was studied. Variability of 45 single nucleotide polymorphism loci (SNP) was analyzed in 7 collections from 5 largest populations of the region. Population structure of East Kamchatka and Chukotka sockeye salmon inferred from single nucleotide polymorphism was roughly in accordance with those previously obtained by

microsatellite analysis. Sockeye salmon samples from North-East Kamchatka and Chukotka were combined into the two regional groups: the first one was represented by local populations from the Kamchatka River drainage, the second one — by the North grouping of populations from the rivers of the West Coast of Bering Sea. Frequencies of alleles and genotypes of SNP loci didn't differ reliably in the samples from Olutorsky Bay rivers (Apuka River and Pakhacha River) and from the lower course of Kamchatka River. A significant divergence was revealed between the island population (Sarannoe Lake, Bering Island) and the "continental" populations. The results presented showed that the spatial genetic structure of the species on the area studied (except for the Commander Islands) is adequately described by the isolation by distance model.

**Chistyakova, A.I., A.V. Bugaev, and O.O. Kim. 2015. On the use of the results of otolith marking for assessment of the ratio between hatchery and wild pink and chum salmon during autumn migrations in the Okhotsk Sea in 2014. Bulletin of Pacific salmon studies in the Russian Far East 10: 147-152. (In Russian).**

Structure of juvenile pink and chum salmon otholits taken from the fish in the trawl catches in the course of the annual complex survey provided by the R/V "Professor Kaganovsky" in October 2014 was considered. Results of the work made it possible to identify marked hatchery fish in mixed samples. There were 15 pink salmon (1,5%) and 62 chum salmon individuals (3,1%) observed with the otholit marks from different Russian Far East and Japan salmon hatcheries. The ratio of the fish from different regions in the catches was found mostly fit the structure of the hatchery marked releases in Russian Far East and Japan, while the ratio between marked Russian and Japan chum salmon in the catches was not to fit. Analysis of the autumn spatial distribution of the pink and chum salmon underyearlings in 2014 has revealed aggregations mostly in the northern part of the Okhotsk Sea.

**Savin, V.A., R.A. Shaporev, A.V. Bugaev, A.V. Zavolokin, and V.S. Yi. 2015. The origin and the distribution of chum salmon *Oncorhynchus keta* stocks in the Western Bering Sea and Northwest Pacific Ocean in summer and autumn in 2013 and 2014. Bulletin of Pacific salmon studies in the Russian Far East 10: 80-95. (In Russian).**

Results of examination of chum salmon *Oncorhynchus keta* (Walbaum) intraspecific structure are represented. Similarity between regional population complexes is estimated on the base of scale structure variety baseline made for 2012-2014. Resolution ability of the baseline models is evaluated. Distribution of chum salmon trawl catches in the Western Bering Sea and Northwest Pacific Ocean is analyzed for 2013–14, and total abundance of mature and immature stocks is estimated. Identification is provided for chum salmon trawl and gill-net catches within the EEZ of Russia for the period of the research.

**Ostrovsky, V.I., Podorozhnyuk E.V., and A.P. Shmigirilov. 2015. Dependence of progeny abundance for fall chum salmon (Oncorhynchys keta) in the Amur River on the parents abundance. Izv. TINRO 183: 41-50. (In Russian with English abstract).**

The stock of the Amur fall chum salmon (*Oncorhynchys keta*) was low in 2000–2005 (annual catches varied in the range of 500–1300 t) but began to increase since 2006 and the catch exceeded 22000 t in 2014. The increasing was accompanied by gradual decrease of abundance for downstream-migrant juveniles of this species. This opposite effect could be related both with excessive fishing pressure and lack of producers or with excess of the producers number over an optimum, i.e. overloading of spawning grounds — that determines strategy of fishery management. To understand the juveniles lowering, the progeny-parents dependence is considered. This dependence is described by original equation for the difference between the number of spawners and number of progeny. The optimal value of the spawners number is defined as approximately 4.5 $10^6$ ind. Recently the number of producers regularly exceeds the optimum. So, recent catch values are not excessive, but insufficient, in spite of low number of downstream-migrant juveniles. This conclusion is consistent with conception on harm of

spawning grounds overloading for salmons reproduction. Possible consequences of this local stock management on the base of strategy of constant exploitation coefficient and permanent residue are discussed.

**Ivankov, V.N. and E.V. Ivankova. 2015. Anthropogenic impact on intraspecific ecological-temporal differentiation and structure of populations of Pacific salmons. Izv. TINRO 181: 23-34. (In Russian with English abstract).**

Intraspecific temporal differentiation and population structure should be accounted in fishery, artificial breeding and introduction of anadromous species to provide stability of their ecological and genetic structure and maintain their high abundance. There is shown for the case of pacific salmons that ignoring of the population structure causes decreasing of the populations and distortion of their nature structure.

**Kaev, A.M. and M.E. Sidorenko. 2015. Forecast and the actual development of the pink salmon fisheries in the main areas of its reproduction in the Sakhalin region in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 35-40. (In Russian).**

**Stekolschikova, M.Yu., A.A. Antonov, O.N. Pal'kina, and Yu.A. Batyuk. 2015. Assessment of abundance of hatchery released pink salmon returned to Sakhalin in 2014 according to data of the otolith marking. Bulletin of Pacific salmon studies in the Russian Far East 10: 121-126. (In Russian).**

## OTHER PUBLICATIONS

**Bugaev, A.V. 2015. Prespawning migrations of Pacific salmon in the exclusive economic zone of Russia: monograph. Petropavlovsk-Kamchatsky, KamchatNIRO. 416 p. (In Russian with English abstract).**

The monography contains analysis of studying of the final stage of Asian Pacific salmon's life at sea. The work was accomplished during prespawning migrations within Russian Exclusive Economic Zone (EEZ) in the waters of the Bering Sea and Pacific Ocean. The analysis was made for a huge data massif, obtained in the course of surveys, made from drift net vessels in the South- Western Bering Sea and North-West part of Pacific Ocean for the period from 1995 to 2008. These data were collected by scientists and workers from several research institutes of fisheries on Far East and in Moscow. The total data pool used for the study includes basic information from control catches and data of biological analysis accomplished in the course of 177 cruises of Russian and Japan drift net vessels (7208 settings of the drift nets). The objects of the study were five species of Pacific salmon: sockeye, chum, pink, Chinook and coho salmon. Biological analysis was provided for 140 thousand fishes. This huge data pool served as a basis for analysis of major criteria of Pacific salmon mass maturation: spatial-temporal distribution, catch dynamics, general biological indexes, feeding and intraspecific structure of prespawning aggregations, and also for figuring out principal factors, determining character of prespawning migrations. The massif of the biological information was systematized for analysis of two periods: of the 1990s and the 2000s, when researches were provided from drift net vessels. Comparative analysis was carried out, considering significant increase in salmon stock abundance recorded in all regions of North Pacific in the early 2000s. The monograph includes numerous former data, helpful to use for further researches. The book is addressed to researches, interested in studying biological aspects of marine period of Pacific salmon life history, ecologists, university students, workers of fishery enterprises and law enforcement agencies, controlling production and catch of salmon.

**Shevlyakov, E.A., and E.S. Fadeev. 2015. Problems and management of fisheries of Pacific salmon in the basin of Kamchatka River and Kamchatsky Bay. Collection of scientific papers "The researches of the aquatic biological resources of Kamchatka and the north-west part of the Pacific ocean" 38: 5–28. (In Russian with English abstract).**
Structure and dynamics of fishery of Pacific salmon have been studied in the River Kamchatka which is the most productive on Kamchatka Peninsula. An increase of pressure of commercial fishery onto salmon populations has been observed in modern period. Comparative analysis for release of adult escapement for spawning in the Lake Azabachye upon different strategies of fishery has been made for one of major groups of sockeye salmon in the basin of the River Kamchatka. Urgent spreading for the practice of release-days a in the course of fishing near shore has been proved for this fishery district. Measures of management, directed to conservation of Pacific salmon stocks and seasonal morphs in the basin of the River Kamchatka have been proposed.

**Radchenko, V.I. 2015. On database of catch and release of the Pacific salmon juveniles supervised by NPAFC. Bulletin of Pacific salmon studies in the Russian Far East 10: 67-79. (In Russian).**

**Markovtsev, V.G., D.V. Marunyak, E.A. Morozova, and A.D. Suyundukov. 2015. Determination of the chum salmon juveniles optimal mass released from the salmon hatcheries of the Primorskiy region. Bulletin of Pacific salmon studies in the Russian Far East 10: 136-139. (In Russian).**

**Barabanshikov, E.I., and M.E. Shapovalov. 2015. Residential form of the cherry salmon (*Oncorhynchus masou*) from the Ussury River basin. Bulletin of Pacific salmon studies in the Russian Far East 10: 140-146. (In Russian).**

**Ignatov, N.N., B.P. Safronenkov, I.K. Smilyanskyi, and A.V. Artyukhin. 2015. Results of estimate of biological and morphological status of juvenile chum salmon in natural pond in the mouth of Kulkuti River in 2015. Bulletin of Pacific salmon studies in the Russian Far East 10: 160-164. (In Russian).**
The materials on biological, morphological and physiological status of juvenile chum salmon in the time of it feeding in the Kulkuty River are presented. It is noted that even short time of cultivation (20-24 days) juvenile chum in the natural pond of Kulkuty River promoted improvement of a biological and physiological conditions and more successful adaptation juvenile chum to habitat.